(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 178 454 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.02.2002 Bulletin 2002/06

(21) Application number: **00810656.9**

(22) Date of filing: **21.07.2000**

(51) Int Cl.[7]: **G08B 13/19**, G08B 13/193, F21S 9/03, H05B 37/02, H01L 31/042

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(71) Applicant: **Greatcell Solar S.A.**
1400 Yverdon-les-Bains (CH)

(72) Inventors:
- **Thiebaud, francis**
  1400 Yverdon-les-Bains (CH)
- **Brooks, Keith**
  1110 Morges (CH)

(74) Representative: **BOVARD AG - Patentanwälte**
Optingenstrasse 16
3000 Bern 25 (CH)

(54) Autonomous infrared sensing apparatus powered by a photovoltaic device

(57) An autonomous infrared sensing apparatus (1) comprising at least:

- a source of energy (2) including at least one photovoltaic element (3),
- an infrared detector (4),
- an optical element (5),
- an electronic circuit (6),

characterised in that the said optical element (5) of the sensing apparatus (1) is physically disposed so as to cover essentially the entire active surface (3A) of the photovoltaic element (3), and :

- said optical element (5) exhibits a high transparency in at least part of the spectrum in which the photovoltaic device (3) is capable of converting photons into electrical energy, and
- at least a part of said optical element (5) acts as an infrared optical element.

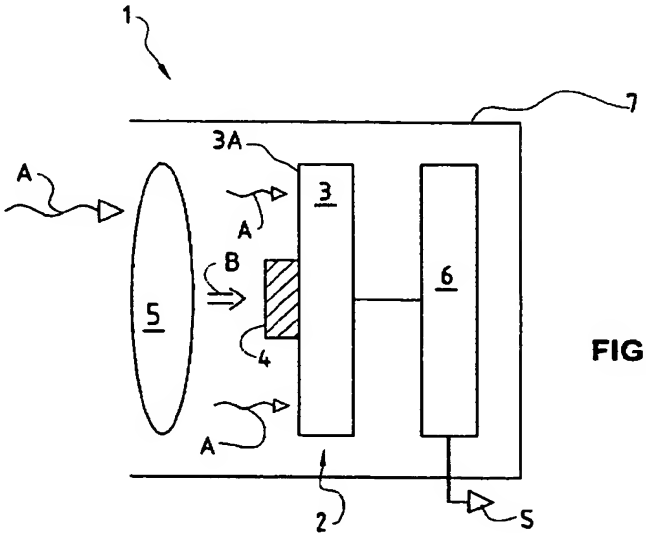


FIG. 1A

EP 1 178 454 A1

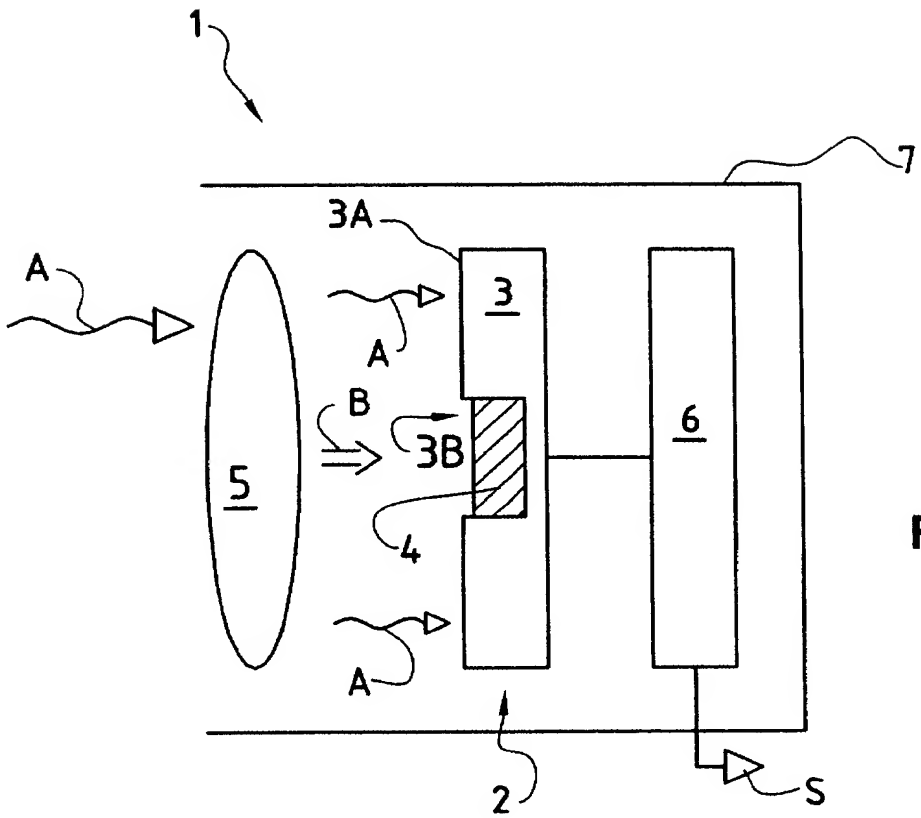


FIG. 1B

Description

[0001] The invention deals with a compact and autonomous infrared sensing apparatus.

[0002] An infrared apparatus comprises at least:

- a source of energy including at least one photovoltaic element,
- an infrared detector,
- an optical element, and
- an electronic circuit.

[0003] This case is well illustrated in the US Patent No. 4,982,176 entitled is "Solar powered lighting and alarm system activated by motion detection".

[0004] One of the drawbacks of this apparatus is that the photovoltaic device is spatially separated from the infrared detector and from the optical element.

[0005] The present invention has as its object to propose a compact and autonomous infrared sensing apparatus which does not present this drawback.

[0006] Another object is to provide an apparatus of the aforementioned type improved in an economical way.

[0007] To this end, the invention has as its subject matter a compact and autonomous apparatus of the aforementioned type, more particularly characterised in that said the optical element of the sensing apparatus is physically disposed so as to cover essentially the entire surface of the photovoltaic device, and :

- said optical element exhibits a high transparency in at least part of the spectrum in which the photovoltaic device is capable of converting photons into electrical energy, and
- at least a part of said optical element acts as an infrared optical element.

[0008] The invention will be better understood from reading the description which follows, given by way of non-limiting example, with reference to the attached drawing in which:

[0009] Figures 1A to 1K : Schematic cutaway drawing of the basic design (fig 1A) of the apparatus according to the invention and of optional designs (fig. 1B to 1K) of the same apparatus.

[0010] Figure 2 : Parts of an autonomous infrared sensing apparatus designed for a compact assembling according to the invention.

[0011] A compact and autonomous infrared sensing apparatus 1 can be seen in the figures 1A to 1K and 2.

[0012] This autonomous sensing apparatus 1 comprising at least:

- a source 2 of energy including at least one photovoltaic element 3,
- an infrared detector 4,
- an optical element 5,
- an electronic circuit 6.

[0013] An infrared detector 4 is a device which absorbs infrared radiation "B" and converts it to an electric signal.

[0014] A photovoltaic element is a device which absorbs incoming photons and converts them to electricity.

[0015] An optical element 5, according to the invention, is a device which at least transmits a part of the incoming electromagnetic radiation "A" to the infrared detector and to the photovoltaic device.

[0016] An electronic circuit 6, according to the invention, is a device which transforms the primary electric signal of the infrared detector in a secondary electronic signal "S" used to activate another electric or electronic element.

[0017] In a notable way, the optical element 5 of the sensing apparatus 1 is physically disposed so as to cover essentially the entire surface of the photovoltaic element 3, and :

- said optical element 5 exhibits a high transparency in at least part of the spectrum in which the photovoltaic element 3 is capable of converting photons into electrical energy, and
- at least a part of said optical element 5 acts as an infrared optical element.

[0018] An autonomous sensing apparatus according to claim 1, characterised in that part of the optical element 5 which has functionality in the infrared part of the spectrum deflects the incoming infrared radiation onto the infrared detector 4.

[0019] In a notable way, the part of the optical element 5 which acts as an infrared optical element is a part which at least deflects the incoming infrared radiation onto the infrared detector 4.

[0020] In a variant, the infrared detector 4 is disposed on the active surface 3A of the photovoltaic element 3 (figures 1A and 1D to 1K).

[0021] The active surface 3A of the photovoltaic element 3 is the part of the surface of this element which absorbs photons and converts them into electricity.

[0022] In another variant, the infrared detector 4 is placed in a cavity 3B in the active surface 3A of the photovoltaic element 3 (figure 1 B).

[0023] In another variant, the infrared detector 4 is disposed behind the photovoltaic element 3 such that infrared radiation "B" reaches said infrared detector 4 through an aperture 3C (figure 1C).

[0024] In this way a sensing apparatus 1 can be con-

structed which is compact.

[0025] In an embodiment, (figure 1D) the source of energy 2 also comprises at least one of the following :

- a non-rechargeable battery 2A,
- a rechargeable battery 2B,
- a capacitor 2C.

[0026] In this way a sensing apparatus 1 can be constructed which is both compact and autonomous.

[0027] In a special design the autonomous sensing apparatus 1 might comprise a peripheral housing 7 including a mirror 8 with the purpose of recapturing photons which have been reflected from the active surface 3A of the photovoltaic element 3, thus increasing the possibility of photon capture by the photovoltaic element 3 (figure 1E).

[0028] Preferably, the autonomous sensing apparatus 1 further comprises an alarm device 9. This alarm device 9 could be for example, a device which uses light or sound to draw attention (figures 1F and 1J).

[0029] In a variant, the autonomous sensing apparatus 1 comprises a switching element 10 for another electric or electronic device 11 (figures 1G and 1I).

[0030] In an embodiment, as pictured on figure 1H , the autonomous sensing apparatus 1 further comprises at least a radio frequency emitter 12 for communication with a second electronic system 13 equipped with at least a radio frequency receiver 14.

[0031] In another embodiment the autonomous sensing apparatus 1 further comprises at least a radio frequency 12 emitter for communication with a switching element 10 equipped with at least a radio frequency receiver 14 (figure 1I).

[0032] In a variant the autonomous sensing apparatus 1 further comprises at least an infrared emitter 15 for communication with a second electronic system 13 equipped with at least an infrared receiver 16 (figure 1H).

[0033] In another variant the autonomous sensing apparatus 1 further comprises at least an infrared emitter 15 for communication with a switching element 10 equipped with at least an infrared receiver 16 (figure 1I).

[0034] In an embodiment the said second electronic system 13 is an alarm device.(figure 1J)

[0035] The autonomous sensing apparatus 1 further comprises at least one additional sensing device 17 for the infrared, ultraviolet or visible radiation (figures 1K and 2).

[0036] The autonomous sensing apparatus further 1 comprises an additional sensing device 17 for the measurement of temperature or humidity (figures 1K and 2).

Claims

1. An autonomous infrared sensing apparatus (1) comprising at least:
   - a source of energy (2) including at least one photovoltaic element (3),
   - an infrared detector (4),
   - an optical element (5),
   - an electronic circuit (6),

   characterised in that the said optical element (5) of the sensing apparatus (1) is physically disposed so as to cover essentially the entire active surface (3A) of the photovoltaic element (3), and :
   - said optical element (5) exhibits a high transparency in at least part of the spectrum in which the photovoltaic device (3) is capable of converting photons into electrical energy, and
   - at least a part of said optical element (5) acts as an infrared optical element.

2. An autonomous sensing apparatus according to claim 1, **characterised in that** part of the optical element (5) which has functionality in the infrared part of the spectrum deflects the incoming infrared radiation onto the infrared detector (4).

3. An autonomous sensing apparatus according to claim 1 or 2, **characterised in that** said infrared detector (4) is disposed on the active surface (3A) of the photovoltaic element (3).

4. An autonomous sensing apparatus according to claim 1 or 2, **characterised in that** said infrared detector (4) is disposed in a cavity (3B) in the active surface (3A) of the photovoltaic element (3).

5. An autonomous sensing apparatus according to claim 1 or 2, **characterised in that** said infrared detector (4) is disposed behind the photovoltaic element (3) such that infrared radiation reaches said detector through an aperture (3C).

6. An autonomous sensing apparatus according to one of the claims 1 to 5, **characterised in that** the source of energy (2) comprises a non-rechargeable battery (2A).

7. An autonomous sensing apparatus according to one of the claims 1 to 5, **characterised in that** the source of energy (2) comprises a rechargeable battery (2B).

8. An autonomous sensing apparatus according to one of the claims 1 to 7, **characterised in that** the source of energy (2) comprises a capacitor (2C).

9. An autonomous sensing apparatus according to one of the claims 1 to 8, **characterised in that** it comprises a peripheral housing (7) and disposed inside said peripheral housing (7), a mirror (8) with the purpose of recapturing photons which have been reflected from the active surface (3A) of the photovoltaic element.

10. An autonomous sensing apparatus according to one of the claims 1 to 9, **characterised in that** it further comprises an alarm device (9).

11. An autonomous sensing apparatus according to one of the claims 1 to 9, **characterised in that** it further comprises a switching element (10) for another electric or electronic device (11).

12. An autonomous sensing apparatus according to one of the claims 1 to 11, **characterised in that** it further comprises at least a radio frequency emitter (12) for communication with a second electronic system (13) equipped with at least a radio frequency receiver (14).

13. An autonomous sensing apparatus according to one of the claims 1 to 11, **characterised in that** it further comprises at least a radio frequency emitter (12) for communication with a switching element (10) equipped with at least a radio frequency receiver (14).

14. An autonomous sensing apparatus according to one of the claims 1 to 11, **characterised in that** it further comprises at least an infrared emitter (15) for communication with a second electronic system (13) equipped with at least an infrared receiver (16).

15. An autonomous sensing apparatus according to one of the claims 1 to 11, **characterised in that** it further comprises at least an infrared emitter (15) for communication with a switching element (10) equipped with at least an infrared receiver (16).

16. An autonomous sensing apparatus according to one of the claims 11 to 15, **characterised in that** said second electronic system (13) is an alarm device.

17. An autonomous sensing apparatus according to one of the claims 1 to 16, **characterised in that** it further comprises at least one additional sensing device (17) for the infrared, ultraviolet or visible radiation.

18. An autonomous sensing apparatus according to one of the claims 1 to 17, **characterised in that** it further comprises an additional sensing device (17) for the measurement of the temperature or the humidity.

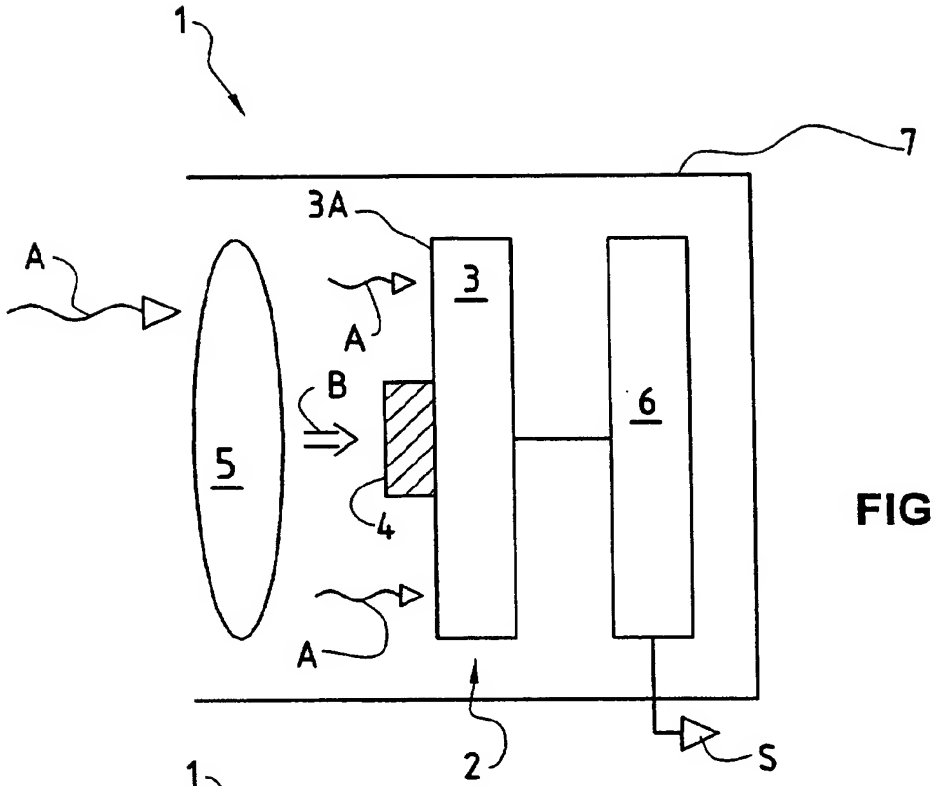


FIG. 1A

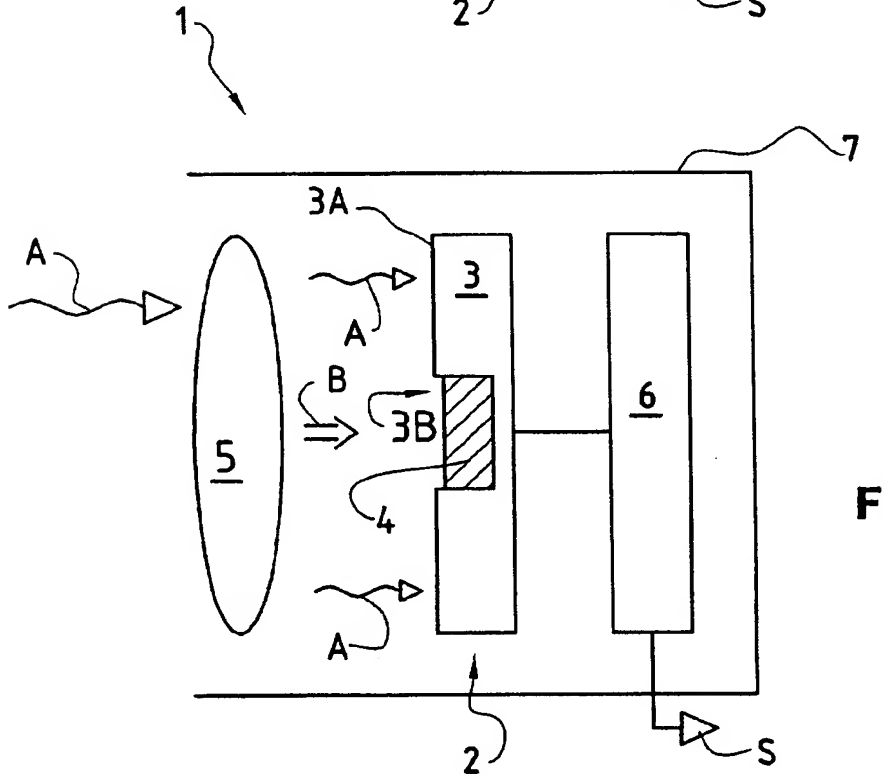


FIG. 1B

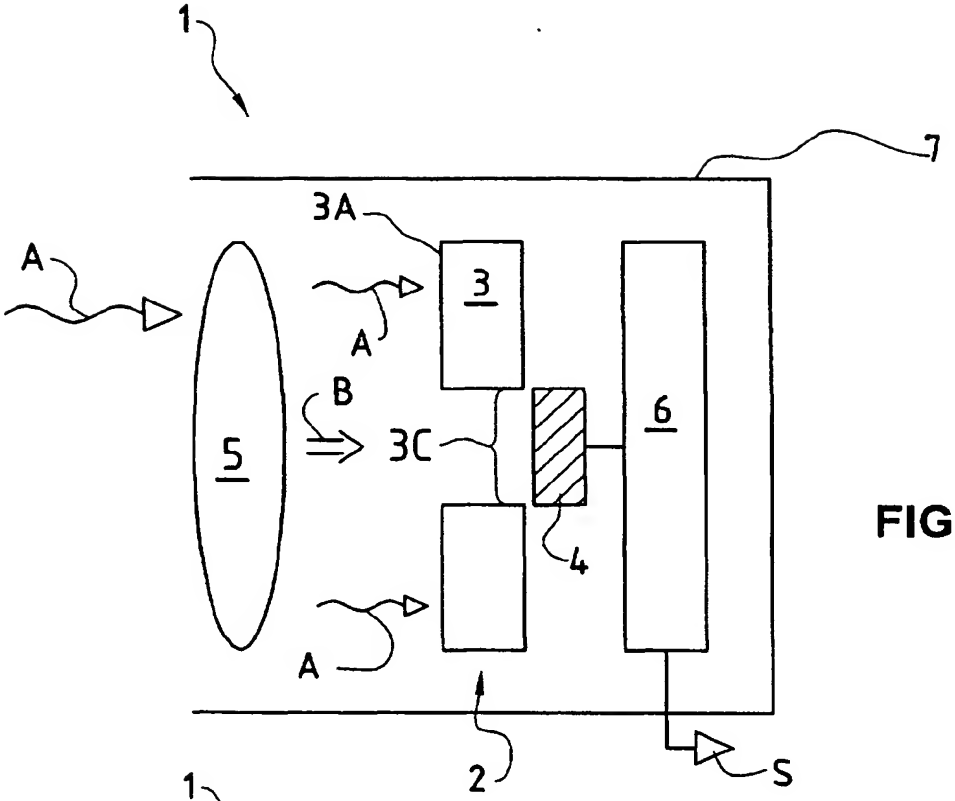


FIG. 1C

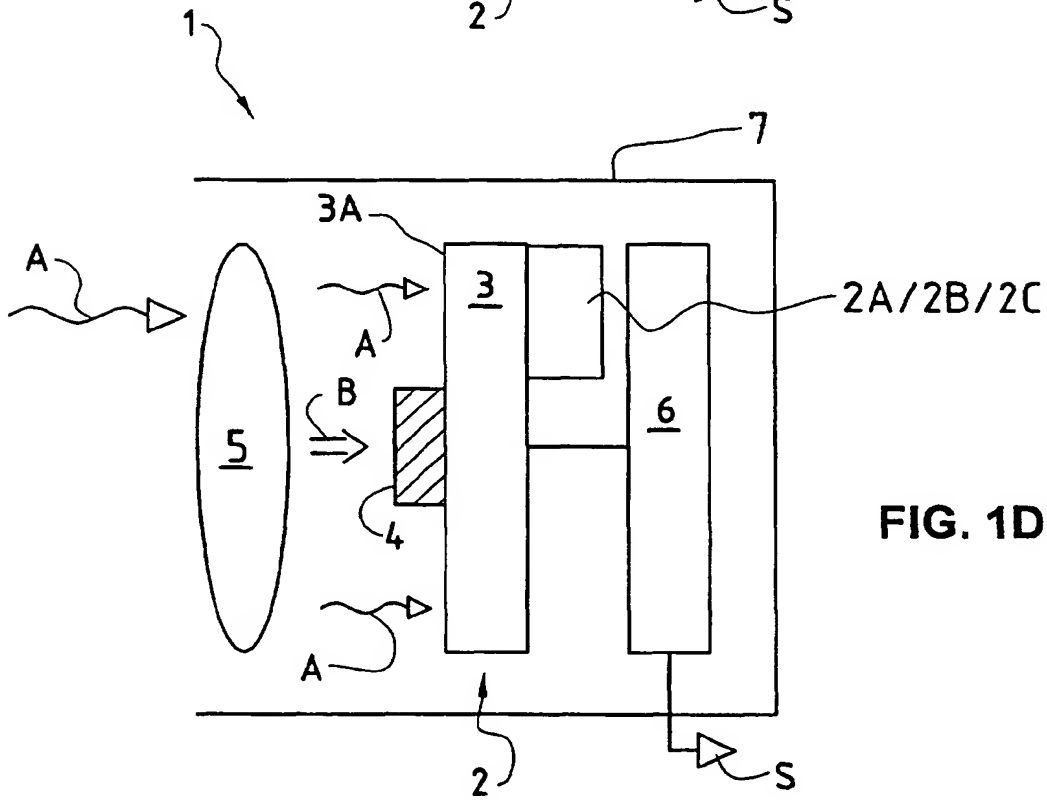


FIG. 1D

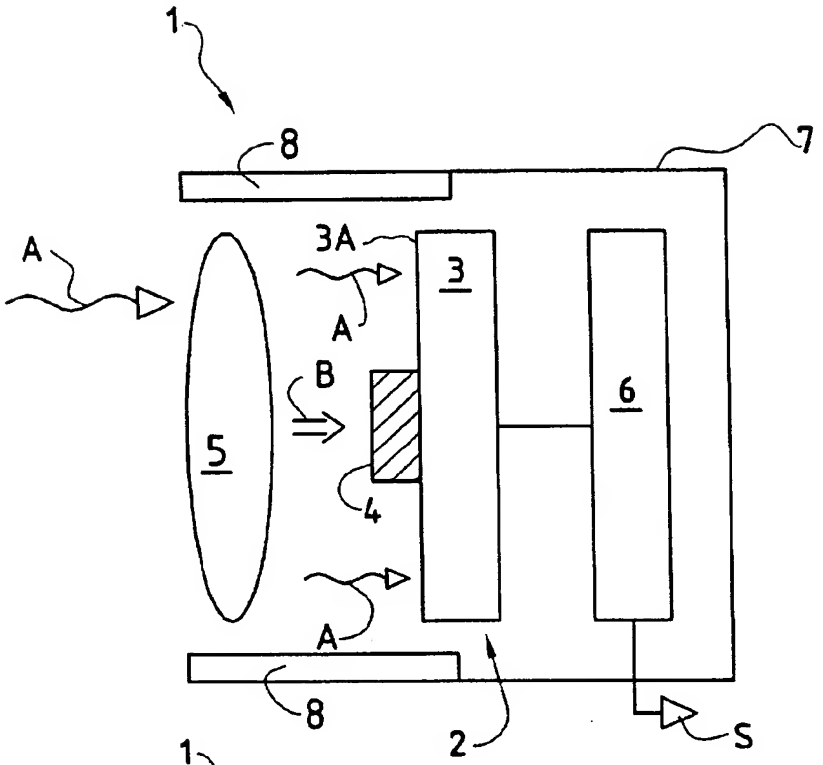


FIG. 1E

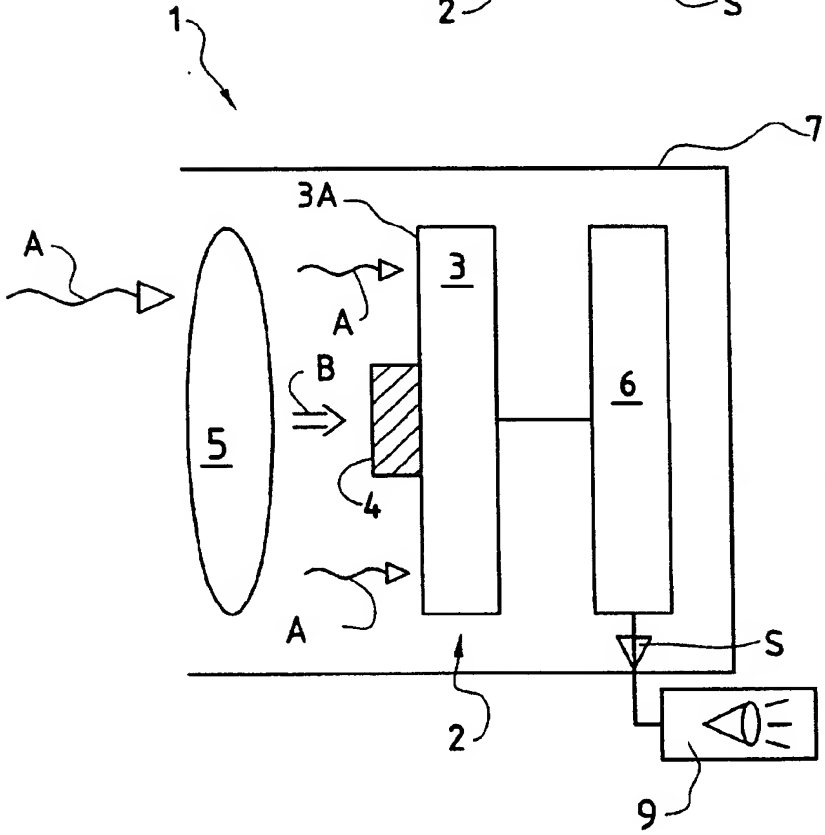


FIG. 1F

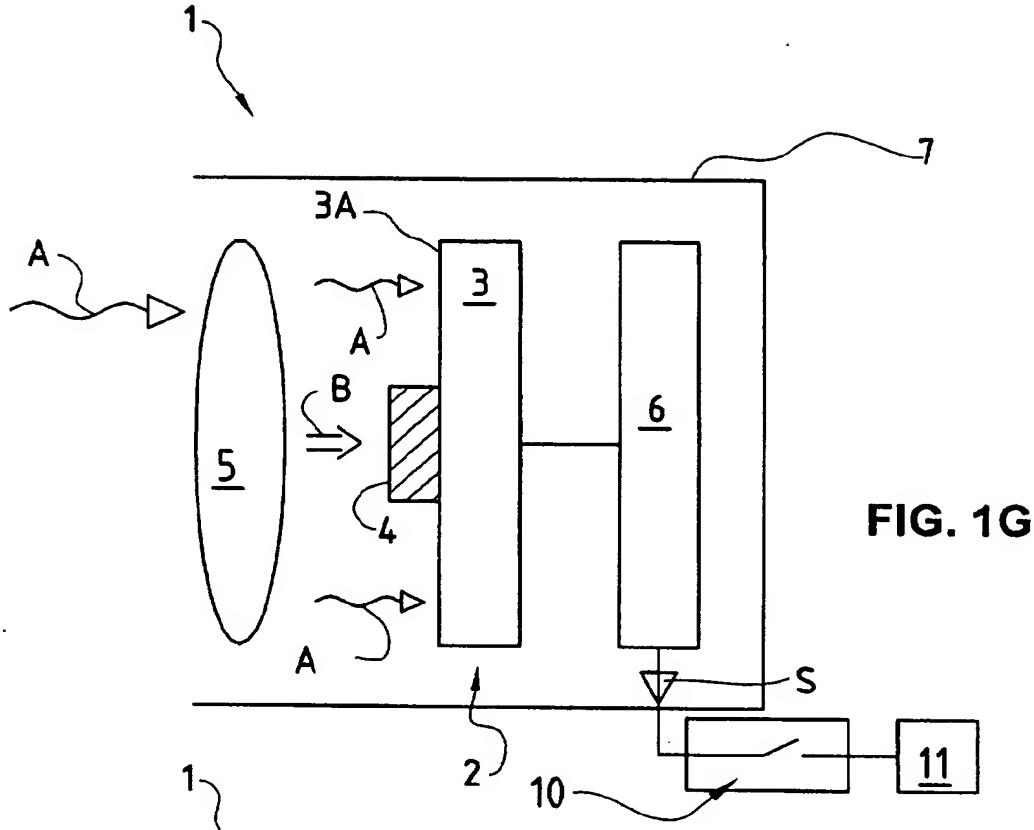


FIG. 1G

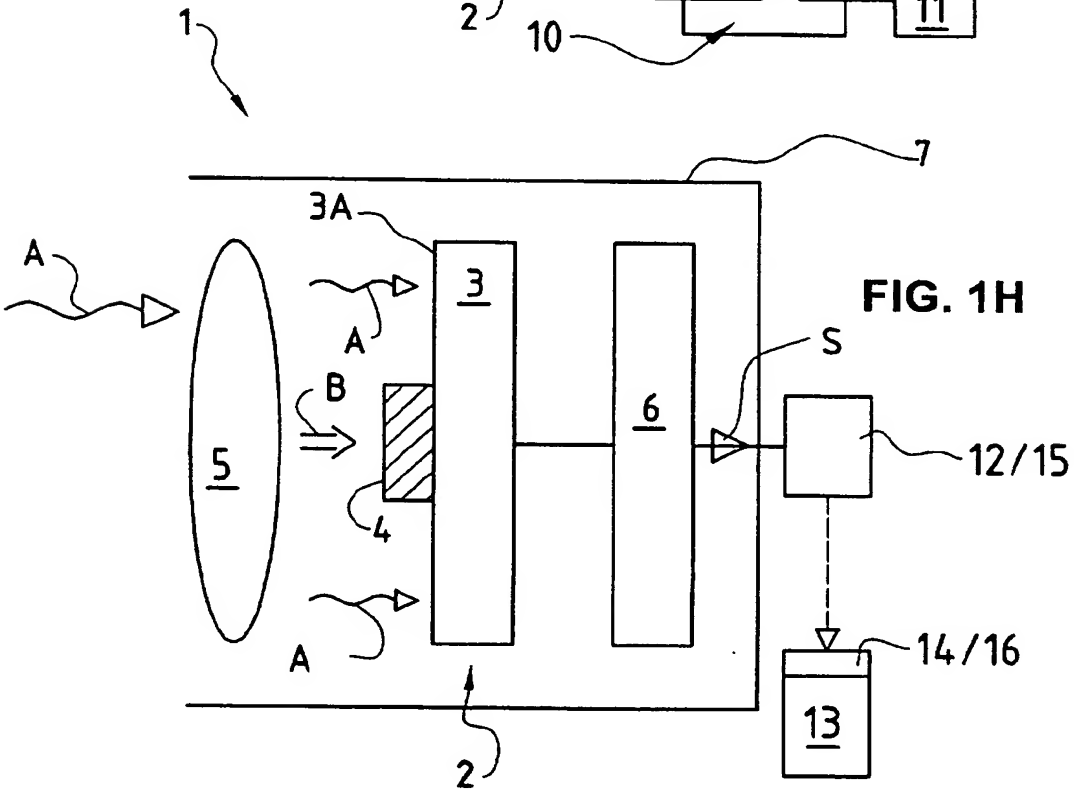


FIG. 1H

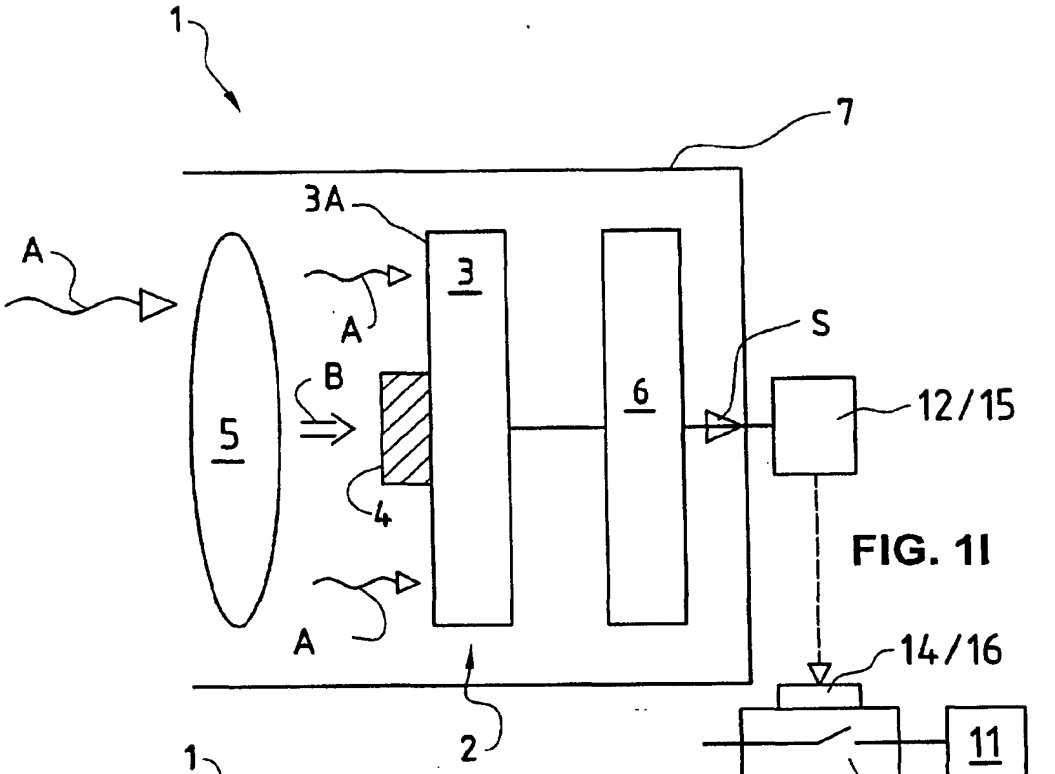


FIG. 1I

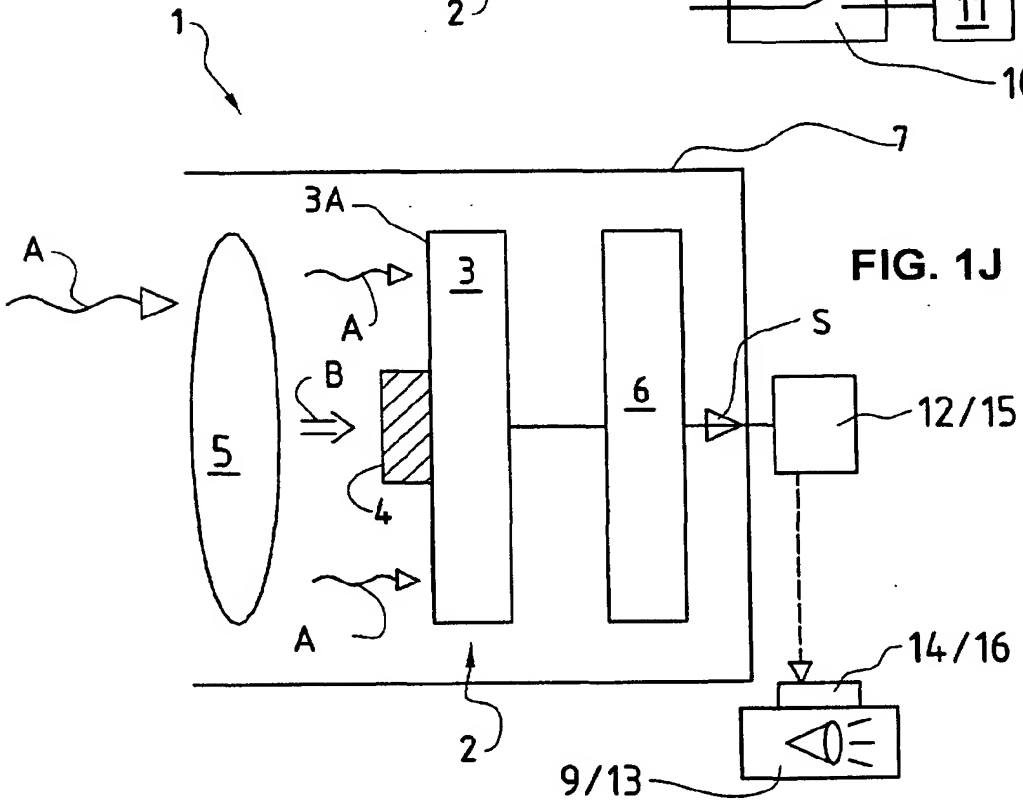


FIG. 1J

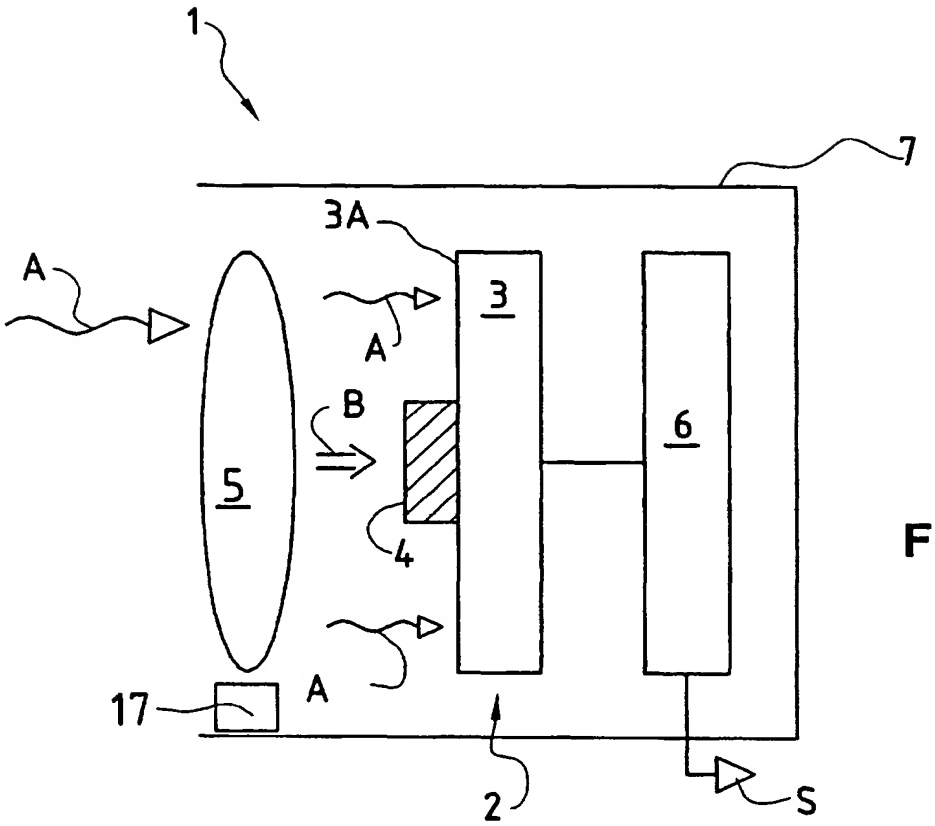
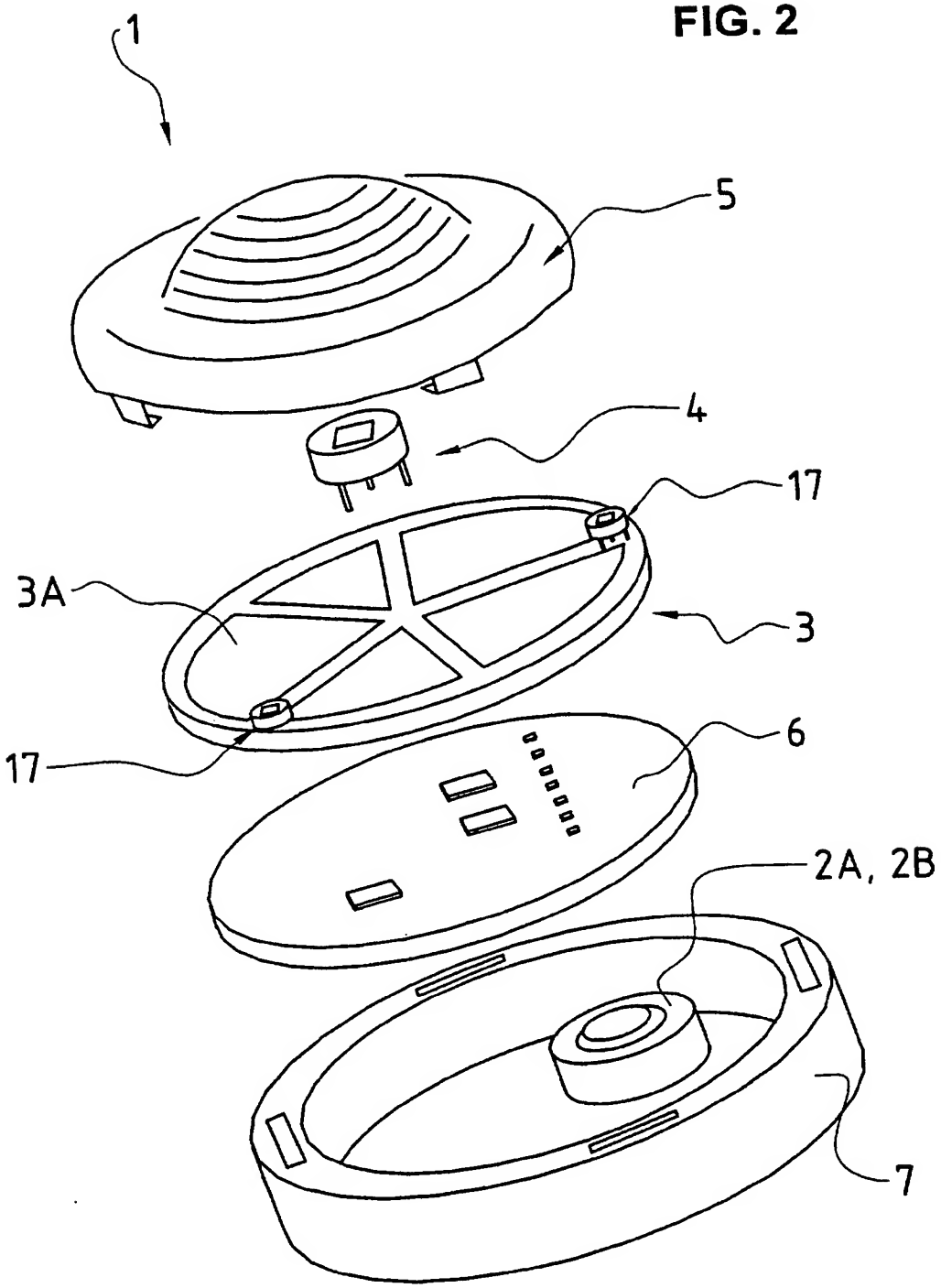


FIG. 1K

FIG. 2



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 81 0656

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	DE 44 19 019 A (PRO INNOVATIO FORSCHUNGSZENTRU) 7 December 1995 (1995-12-07) * figures 1,2 * * claim 4 *	1,6, 10-12	G08B13/19 G08B13/193 F21S9/03 H05B37/02 H01L31/042
Y	DE 298 23 657 U (ROEHM GMBH) 9 September 1999 (1999-09-09) * page 5, line 9 - line 15 *	1,6, 10-12	
A	DE 297 18 173 U (RICHTER ULRIKE) 8 January 1998 (1998-01-08) * the whole document *	1,13-15	
D,A	US 4 982 176 A (SCHWARZ FRANK) 1 January 1991 (1991-01-01) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

G08B
F21S
H05B
H01L
F21L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 December 2000	De la Cruz Valera, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 81 0656

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-12-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4419019 A	07-12-1995	NONE	
DE 29823657 U	09-09-1999	DE 19834016 A AU 1153499 A WO 9919914 A	22-04-1999 03-05-1999 22-04-1999
DE 29718173 U	08-01-1998	NONE	
US 4982176 A	01-01-1991	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82